

brevity of the treatment is probably an advantage. A short bibliography forms a useful appendix.

As implied in the title, the author's object has been to give a general outline of the fundamental theory, and not to enter into detailed discussions of applications. The book thus deals exclusively with the theoretical, as distinct from the experimental, aspect of thermodynamics. It may with advantage be studied in conjunction with any treatise in which the theory of heat is studied from the experimental side, and a clearer understanding of the subject will be obtained than would have been the case had Mr. Buckingham written a larger volume, containing a mixture of theoretical and experimental investigations. In a subject like thermodynamics, the fundamental axioms cannot, as a rule, be verified directly by experiment, and we are compelled to use what Dr. Stoney calls the *a posteriori* method. The evidence in favour of the axioms is mainly derived from comparing the conclusions to which they lead with the results of observation. It is important in the theoretical investigation that no assumption should be made which is not expressly stated, and Mr. Buckingham appears at least to have exercised considerably more vigilance in this respect than any previous writer. We should like to see an outline of the theory of electromagnetism treated on parallel lines. Mr. Buckingham's treatise will be an indispensable addition to the library of every physicist or physical chemist, as well as of every applied mathematician who studies thermodynamics, and the author has done much to place the introductory treatment of the subject on a sound and rational basis.

AN AUTHORITATIVE TEXT-BOOK OF PHYSIOLOGY.

Text-book of Physiology. Edited by E. A. Schäfer. Vol. ii. Pp. xxiv. + 1365. (Edinburgh and London: Young J. Pentland, 1900.)

THIS volume consists of 1258 pages of text, 97 pages of indices (subjects and authors), and is illustrated by 449 woodcuts. There is no preface. The following epitome shows the subjects dealt with, their respective authors, and, in brackets, the length of each article:—"Mechanism of the Circulation of the Blood," by L. Hill (1-168); "Contraction of Cardiac Muscle," by W. H. Gaskell (169-227); "Animal Mechanics" (228-273), "Sense of Taste" (1237-1245), "Smell" (1246-1258), J. B. Haycraft; "Muscular and Nervous Mechanism" of "Respiratory Movements" (274-312), of the "Digestive" (313-337), "Urinary" (338-346) and "Generative Tracts" (347-351), E. H. Starling; "Properties of Striped Muscle" (352-450), J. Burdon Sanderson; "Nerve" (451-560), "Electrical Organs" (561-591), Francis Gotch; "Nerve Cell" (592-615), "Cerebral Cortex" (697-782), E. A. Schäfer; "Sympathetic Nervous System" (616-696), J. N. Langley; "Spinal Cord" (783-883) and "Parts of Brain below Cerebral Cortex" (884-919), "Cutaneous Sensations" (920-1001) and "Muscular Sense" (1002-1025), C. S. Sherrington; "Vision" (1026-1148), W. H. R. Rivers; "Ear" (1149-1205), "Vocal Sounds" (1206-1236), J. G. McKendrick and Albert A. Gray.

Those familiar with the modern development and advances recently made by British physiologists will see

at once that the selection of authors is a guarantee of the excellence and accuracy of the subject-matter of the several essays; for they may be regarded as such, each essay containing the results of the observations to which the author has directed his particular attention.

It appears to us that Hill's article on the circulation is an excellent *résumé* of the subject, and the author acknowledges that he is greatly indebted to the perhaps not sufficiently well-known "Lehrbuch der Physiologie des Kreislaufes," by R. Tigerstedt (1893), who has recently become professor of physiology in Helsingfors. There has been incorporated all those recently discovered facts bearing on the action and distribution of vaso-motor nerves, and influence of gravity on the circulations, with which readers of the *Journal of Physiology* are familiar.

Gaskell's paper is a philosophic discussion of the many observations that have been made on the action of cardiac muscle. It is done with a master hand, and by one who has materially advanced our knowledge of the subject. Gaskell explains the beat of the heart, the sequence of its contractions, &c., without bringing in ganglion cells at all; and he sees no more reason to assign special functions to these cells than to any other of the peripheral efferent nerve cells; and we think that he makes good his case.

Starling's articles give a clear and precise account of the subjects with which they deal, but we confess that we think a short chapter on the comparative physiology of some of the subjects would have been most valuable. In discussing the influence of the higher parts of the brain on the respiratory centre, we failed to find noted the researches of Marckwald on the effect of plugging the blood-vessels of certain cerebral areas by injecting coloured fluid paraffin wax. These results point to the importance of the posterior quadrigemina and the nuclei of the sensory part of the fifth cranial nerve as important factors in the discharge of rhythmical respiratory impulses (*Zeit. für Biol.*, vol. xxvi.). The earlier observations of Marckwald are given. We are glad to see a full exposition of the work of Kronecker, Meltzer and others on swallowing of liquids.

The mechanical, thermal and chemical properties of striped muscle are exhaustively treated by Burdon Sanderson, as was to be expected from one who has devoted so much time to the study of the time relations of muscle in action, and who, by the introduction of new methods, has added materially to the apparatus by which time-problems in other tissues may be solved. The same may be said of the admirable article on "Nerve" by Gotch, while his paper on "Electrical Organs" groups up succinctly the chief facts and theories regarding these wonderful organs. As to the nature and activity of these organs, Gotch is led to the view that, as the only excitable structures there present are the nerves and their fine terminations, the organ change is closely related to the production of molecular disturbances in its contained nerves. In any case, he regards the essential primary disturbance constituting the organ shock as nervous.

In the editor's article on the "Nerve Cell" we have, as a basis, a *résumé* of the more recent advances in the minute structure of these organs. The modern "theory of isolated units," often spoken of as the "neurone theory," he regards as by no means conclusively proved. In any

case the "neuron" terminology, as introduced by Waldeyer, has taken deep root in neurology.

Langley's article on the sympathetic and allied nervous systems is a masterly summary of a subject which, by his researches, he has made peculiarly his own, and groups up in an easily accessible form the many scattered observations on this subject.

The important topic of the "Cerebral Cortex" is fully dealt with by the editor. In mentioning the old experiment of Kircher, known as the "experimentum mirabile," it is set down to "Kirschner" (p. 712). Several of the illustrations are acknowledged from the well-known work of François-Franck and Pitres. The author deprecates the use of the term "sensori-motor," as applied to denote the so-called "motor" or excitable centres in the Rolandic area, although he does not object to the term "psychomotor" applied to them. A difficult subject is dealt with in a terse but comprehensive manner.

Sherrington's article on the spinal cord displays a mastery of his subject which at once elicits one's admiration. Necessarily, in dealing with the mass of detail many new terms have to be coined for the numerous phenomena which have been discovered in recent years. There is a due admixture of the historical with the results of recent research. What the Germans call Bell's law appears here as "Bell-Magendie law." The word "Bahnung," introduced by Exner into nerve physiology, is, we think, better rendered by "facilitation," adopted by Sherrington, than any of the other proposed equivalents we have seen.

It is evident that a large amount of industrious application has been expended by Sherrington on his articles on "Cutaneous Sensations" and on "Muscular Sense." In the former we find the recent work of Goldscheider, v. Frey and Kiesow treated with ample detail; but perhaps the article on the "muscular sense," grouping up as it does the numerous stray observations, will attract much attention. The value of Sherrington's own work on the "Muscle-spindles," which he showed degenerated after section of the posterior nerve roots outside the spinal ganglion, laid the basis of a more definite physiology regarding the important part played by certain afferent impulses from striped muscle in regulating the activities of the parts from which they proceed. Indeed, the chapter on "the peripheral apparatus of the muscular sense," though short, is an excellent *résumé* of the present knowledge of this important subject, and to which clinicians will find it profitable to devote their attention.

The essay on "Vision" is somewhat unequal, but how can it be otherwise on a subject so vast and which is treated with such wealth of detail in Hermann's "Handbuch der Physiologie."

Although necessarily there is much comparative physiology scattered throughout its pages, we could have wished to see the main facts of the comparative physiology of at least some of the subjects summarised in separate chapters. The work is one which reflects great credit on British physiologists, and we heartily congratulate the editor on its production—a work which must have entailed great labour and careful supervision. Perhaps when the next edition is called for it may be issued in three volumes, as volume ii. has reached rather bulky dimensions.

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THE ROYAL OBSERVATORY, GREENWICH.

The Royal Observatory, Greenwich; its History and Work. By E. W. Maunder. Pp. 320. (London: the Religious Tract Society, 1900.)

THE history of the Royal Observatory extends over two centuries and a quarter, and its work is certainly not lacking in general interest; yet Mr. Maunder seems to be the first person to produce a popular account of them, and he has left little room for improvement to any one who comes after him in the near future. The history occupies the first 124 pages of the book in five chapters, and the description of the place as it is to-day, and the work as it is now going on, occupy the other 192 pages in eight chapters. This is probably a fair arrangement. Those who would have liked a little more of the history can find it in such works as Bailey's "Life of Flamsteed," or Rigaud's "Life of Bradley." A "Life of Halley," on a scale worthy of him, has long been wanted, and has several times been nearly undertaken, but the project has, for one reason or another, always fallen through.

The predecessors of the present Astronomer Royal number seven: Flamsteed, Halley, Bradley, Bliss, Maskelyne, Pond, Airy. Of these Bliss only filled the position for two years; but the others lived long and worked hard at their posts, Flamsteed, Maskelyne and Airy for nearly half a century each; Halley, Bradley and Pond for nearly a quarter. And though there is so much straightforward routine work in astronomy, especially at a national observatory (and among national observatories, especially at Greenwich), yet the names of the Astronomers Royal are all associated with one or two notable events, often, though not always, special achievements of their own. The name of Flamsteed calls up at once the foundation of the observatory (which was in great measure due to him), and unfortunately also the quarrel with Newton; that of Halley, the publication of the *Principia*, and the first prediction of the return of a comet; that of Bradley, the discovery of Aberration and Nutation, as well as his fine catalogue of stars; that of Maskelyne, the invention of lunar distances and the chronometer, and the establishment of the *Nautical Almanac*. Airy deserves to be remembered as the man who first suggested how to compensate the compass in iron ships, though, like Flamsteed, he was unfortunate enough to leave another reputation, from his attitude towards the discovery of Neptune. Pond and Bliss are something of exceptions; but the former has recently been eulogised by Mr. Chandler as a phenomenal observer; and even of Bliss we may say that it was a distinct achievement to leave behind him only one authentic portrait, and that scratched by a boon-companion on a pewter-flagon! The seven Astronomers Royal were not only men of ability, who worked hard, but men of clear-cut individuality; and their average length of life was nearer four score years than three score years and ten. We ought to have all their portraits in our National Portrait Gallery, including an electrotype of that curiosity inscribed "This sure is Bliss, if Bliss on earth there be."

Mr. Maunder has given us the main facts of these interesting lives in a thoroughly readable form. He then passes on to the Observatory as it is now, and we must